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SPECIFICATION FOR GRINDING AND POLISHING MATERIALS FOR OPTICAL COMPONENTS

UDC 621·921 : 681·7·03

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3

July 1986

Indian Standard

SPECIFICATION FOR GRINDING AND POLISHING MATERIALS FOR OPTICAL COMPONENTS

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Indian Standard

SPECIFICATION FOR GRINDING AND POLISHING MATERIALS FOR OPTICAL COMPONENTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 17 September 1985, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 This standard aims at describing the various grinding and polishing materials required in processing of optical components. The standard also incorporates the various optical and physical properties of such materials and thus makes the selection of a material for a particular use quite simpler.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the optical and physical characteristics and uses of various types of grinding and polishing materials generally used for processing of various types of optical components.

1.1.1 Optical components considered shall be made of the following basic materials:

a) Optical glass;
b) Optical plastics;

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* Rules for rounding off numerical values (*revised*).

c) Crystalline materials such as calcite, quartz, rocksalt, fluorite, halides, germanium, arsenic trisulphide, irtran, etc ;

d) Gem stones; and

e) Metals.

2. TYPE

2.1 Abrasives considered shall be classified into two categories, such as those occurring in nature called natural abrasives and others manufactured synthetically called artificial abrasives.

2.2 Grinding and polishing materials considered shall be in the form of loose powder or paste or bonded into wheels, discs or blocks.

3. TERMINOLOGY

3.1 For the purpose of this standard, the definitions as given in IS : 1399-1959* and IS : 3178-1965† shall apply.

3.2 Levigation/Elutriation — It is the process of grading abrasives and is based on the time taken by the grains of an abrasive in passing through a vessel of water one metre high and about 0·30 metre in diameter.

3.3 Sieving/Sifting — It is the process of grading abrasives and employs the use of a sieve or screen having a fixed number of meshes per linear unit of its length.

4. MATERIALS

4.1 The various materials together with their physical and optical characteristics as well as end uses are given in Table 3.

5. GENERAL REQUIREMENTS

5.1 An abrasive intended for use in grinding and polishing of an optical part shall be totally free from grains of other foreign materials.

5.2 A perfectly graded abrasive shall have all grains of the specified range of sizes.

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*Glossary of terms used in optical technology.

†Specification for abrasive emery grain.

5.3 All abrasives shall be classified as required under 6 of this specification.

5.4 An abrasive shall be hard enough so as to bite the material being ground or polished under normal working pressure.

6. METHOD OF SELECTION OF ABRASIVE FOR PARTICULAR USE

6.1 The selection of a suitable material for grinding and polishing of a particular component shall mainly depend on physical and other characteristics of both the material and the optical component to be worked.

6.2 As a general principle, the material chosen for grinding and polishing a particular optical component shall have hardness greater than the latter.

6.3 A material chosen for grinding or polishing a particular optical component shall not be that hard as to get lodged inside the component under normal grinding or polishing pressure.

6.4 After selecting a suitable material for the intended purpose, the proper grade shall be chosen for the particular finish required. In case the intended grade is not available, choice for the next best suitable material shall be made, if possible.

7. CLASSIFICATION OF ABRASIVES

7.1 The coarse and medium series of abrasive shall be classified in grit numbers which indicate the grain sizes of the particles expressed in mm/microns.

7.1.1 Coarse and medium series of abrasives shall be classified by seiving process corresponding to IS : 2405 (Part 1)-1980* and IS : 460 (Part 1) - 1978† and shall be designated as corresponding to IS : 3178-1965‡.

7.1.2 Microgrit sizes of abrasives shall be classified by sedimentation process and shall be designated as given in Table 1.

7.1.3 Diamond powder pastes shall be designated in different grades depending upon the particle size of the diamond. The diamond pastes of different grade shall conform to a uniform colour code to facilitate easy

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*Specification for industrial sieves : Part 1 Wire cloth sieves (*first revision*).

†Specification for test sieves : Part 1 Wire cloth test sieves (*second revision*).

‡Specification for abrasive emery grain.

identification of the grade. Suggested code is given in Table 2. These pastes are to be supplied in collapsable plastic tubes or syringes.

TABLE 1 MICROGRIT SERIES

(*Clause* 7.1.2)

DESCRIPTION	MEDIUM 50 PERCENT VALUE* IN MICRON	3 PERCENT LIMIT*, *Max*	94 PERCENT LIMIT*, *Min*
302 (M2)	28±1·5	48·5	16
302 (M2·5)	20±1·0	38	8
303 (M3)	14·5±1·0	31	5·5
303½ (M3.5)	10±1·0	25	3
304 (M4)	8±1·0	22	2
305 (M5)	5±0·8	18·5	0·5

*The 3 percent limit means that a maximum of 3 percent is allowed to be coarser than the value shown in microns. The 94 percent limit means that a minimum of 94 percent shall be coarser than the value shown in microns. The medium value is 50 percent point on a particle size distribution curve based on measurements by sedimentation method given under **3**.

TABLE 2 DIAMOND PASTES

(*Clause* 7.1.3)

PARTICLE SIZE IN MICRONS	SUGGESTED COLOUR CODE	GENERAL APPLICATION
90	Black and its varying shades	Fast stock removal
60	Dark red	
45	Bright red	
25	Orange	
14	Yellow	Lapping and pre-polishing
8	Green	
6	Blue	
3	Indigo	Final polishing
1	Violet	
0·25	White	

8. DETERMINATION OF PARTICLE SIZE AND TESTS

8.1 The measurement of particle size shall be done by making use of sedimentation principle which is bassd on Stoke's Law. Mathematically speaking this law is stated as under :

$$D=\frac{K}{T}$$

where

D = Diameter of particles in microns; and

T = Settling time in minutes and K is Stoke's constant whose value will depend on the material being tested, temperature and sedimentation medium.

8.2 Description of the Method

8.2.1 The apparatus consists of a vertical sedimentation tube of 100 cm long and 20 mm internal diameter surrounded by a glass water jacket and connected to a special collecting tube graduated in mm. The assembly as shown in Fig. 1 is mounted on a frame whose base plate has adjusting screws for perpendicular setting. The apparatus is used at constant temperature condition.

8.2.2 *Method of Test*

8.2.2.1 Fill the sedimentation tube with sedimentation medium (which is normally 95 percent methyl alochol). Ensure that the room temperature and water jacket temperature is constant at this juncture.

Place sufficient amount of sample in a test tube to ensure a height of say 20-25 mm in the collecting tube after sedimentation. Add some sedimentation liquid and a little of dispersing agent (1 percent aqueous solution of tetrasodium salt) and shake the mixture thoroughly for nearly 30 minutes.

Place a suitable funnel on the sedimentation tube. With the thumb held tightly over the open end of the test tube shake the tube vigorously for a little while and transfer the contents quickly to the sedimentation tube through the funnel. Quickly remove the funnel from the top of the sedimentation type to prevent any mineral from dropping into the tube after setting has begun, because this will distort the results.

Using a stop watch record the time of initial point is the time when the first steady scream of particles reaches the bottom of the collecting tube. Examine the falling particles for signs of agglomeration, if the latter is there, reject the sample. Record subsequent point, that is, the time and the height of the sample in mm in the collecting tube. The end point is the time when all the particles have settled.

During sedimentation tap the rubber stopper holding the bottom of the collecting tube gently and continuously for proper recording of the sediment height.

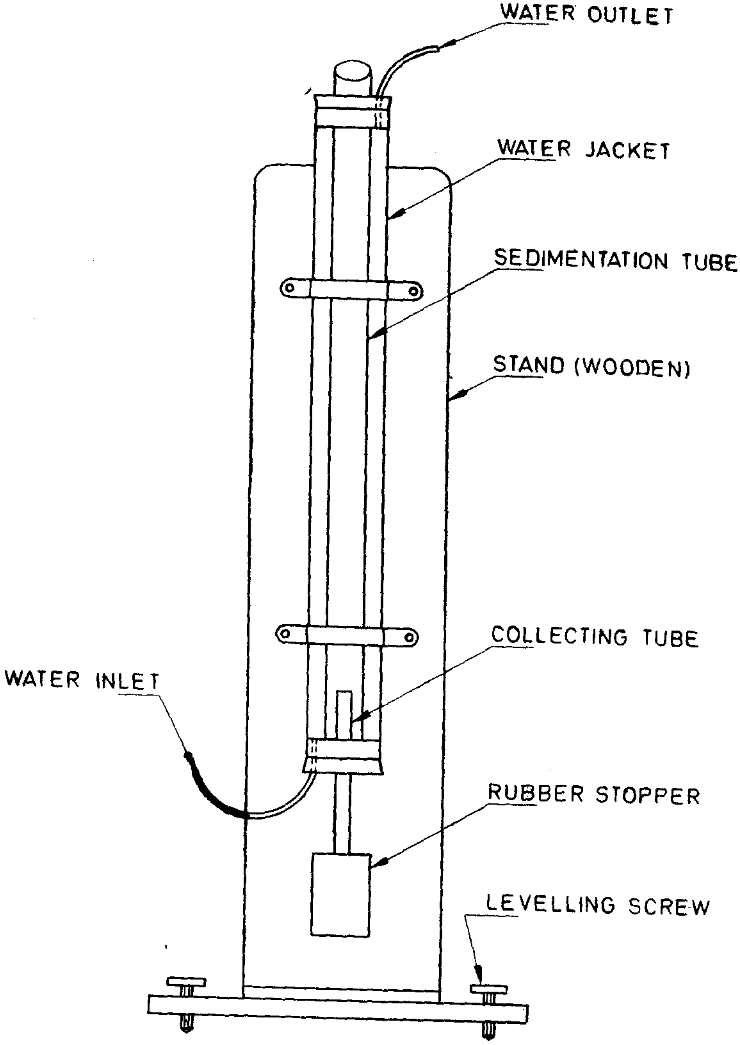

FIG. 1 SEDIMENTATION APPARATUS

9. PACKING

9.1 Coarse and medium varieties shall be packed in strong fibre-board drums or double-sheet plastic bags and suitably sealed.

9.2 Fine varieties of abrasives shall be packed in plastic/metal containers.

10. MARKING

10.1 The bags or tins containing the abrasive shall be properly labelled. The label shall give the following information :

a) Name of abrasive,
b) Grain size/grit number,
c) Weight of abrasive,
d) Weight of abrasive with container, and
e) Manufacturer's complete address.

10.1.1 The bags or tins containing the abrasive may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Mark) Act and the Rules and Regulations made thereunder. The ISI mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are alsb continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

TABLE 3 MATERIALS AND THEIR CHARACTERISTICS

(Clause 4.1)

SL No.	MATERIAL	CHEMICAL FORMULA	NATURAL/ SYNTHETIC	HARDNESS	COLOUR	GRADES RECOMMENDED FOR COMMON USE	REMARKS/END USES
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	Diamond	C	Natural and synthetic	10 Moh 6 000 knoop	Colourless when pure, often show tints of white grey, blue yellow or green	From 90 microns down to 0·25 microns	Grinding and polishing of gem stones, crystals of similar hardness and metals
2.	Corundum	Al_2O_3	Natural	8·8 Moh 1 900 knoop	Colourless	Coarse and medium grades—as per IS : 3178-1968	Grinding and polishing of fluorspar and other crystals of similar hardness
3.	Emery	Chiefly Al_2O_3	Natural	8 Moh	Dark brown	Fine grades — M_2 to M_6	Grinding and optical glass and hard crystal
4.	Alonite or alundum	Al_2O_3	Synthetic	9 Moh 2 000 knoop	Colourless		Grinding of optical glass, crystals, plastics and hard crystals
5.	Carborundum	$Si\ C$	Synthetic	9 ++ Moh 2 500 knoop	Bluish black		Grinding of glass quartz and other hard crystals
6.	Quartz	$Si\ O_2$	Natural	7 Moh	Grey		As polishing agent for softer materials
7.	Boron carbide	$B_4\ C$	Synthetic	9+Moh 2 250 knoop	Black		Lapping of crystal components
8.	Jasper	Chiefly $Si\ O_2$	Natural	7 Moh	Red		Used as grinding powder for softer material

9.	Pumice	SiO_2 + Al_2O_3	Natural	6 Moh	Greyish white	—	Fine smoothing and polishing of soft crystals
10.	Tripoli	Mainly SiO_3	Natural	6-7 Moh	White	—	Grinding and polishing of crystals
11.	Rouge	Fe_2O_3	Synthetic	5·5 to 6·5 Moh	Red (of varying shades)	M4 and M5	Polishing of quartz and similar crystals. For rapid polishing of spectacle lenses. For precision polishing of optical glass
12.	Glassite (blackrouge)	Fe_2O_3	Synthetic	5.5 to 6·5 Moh	Black	M4 and M5	Polishing of soft crystals like calcite, etc
13.	Cerium oxide	CeO_2	Synthetic		Pale yellow	M4 and M5	Rapid polishing of optical glass plactics and metals
14.	Ziroonium oxide	ZrO_2	Synthetic	5·5 to 6·5 Moh	White	M4 and M5	Optical glass polishing
15.	Chromium oxide	Cr_2O_3	Synthetic	7 to 7·5 Moh	Bright green	M4 and M5	Polishing of harder crystals
16.	Titanium oxide	TiO_2	Synthetic	3.8 to 4·2 Moh, 925 knoop	White	M5	Polishing of soft materials such as plastic and crystals
17.	Putty Powder	SnO	Synthetic	6 - 7 Moh	White	M5	For polishing of plastic and soft crystals